Claims

1. A nucleic acid oligomer modified by attaching a catalytically redox-active moiety, characterized in that the catalytically redox-active moiety includes one or more electron-donor molecules and/or one or more electron-acceptor molecules and, additionally, one or more macromolecules.

2. The modified nucleic acid oligomer according to claim 1, characterized in that the catalytically redox-active moiety is covalently attached.

3. The modified nucleic acid oligomer according to claim 1 or 2, characterized in that the catalytically redox-active moiety is covalently attached via one or more electron-donor molecules.

4. The modified nucleic acid oligomer according to one of claims 1 through 3, characterized in that the catalytically redox-active moiety is covalently attached via one or more electron-acceptor molecules.

5. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that the catalytically redox-active moiety is covalently attached via one or more of the macromolecules.

6. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that the catalytically redox-active moiety is a redox-active enyzme.

7. The modified nucleic acid oligomer according to claim 6, characterized in that the catalytically redox-active moiety is the native or modified glucose oxidase.

8. The modified nucleic acid oligomer according to claim 6, characterized in that the catalytically redox-active moiety is the native or modified alcohol dehydrogenase or fructose dehydrogenase.

9. The modified nucleic acid oligomer according to claim 6, characterized in that the catalytically redox-active moiety is the native or modified lactate dehydrogenase.

10. The modified nucleic acid oligomer according to claim 6, characterized in that the catalytically redox-active moiety is a native or modified peroxidase.

11. The modified nucleic acid oligomer according to one of claims 1 through 5, characterized in that one or more of the electron-donor and/or electron-acceptor molecule(s) are pigments, especially flavins or (metallo)porphyrins or derivatives thereof.

12. The modified nucleic acid oligomer according to one of claims 1 through 5, characterized in that one or more of the electron-donor and/or electron-acceptor molecule(s) are nicotinamides or quinones, especially pyrrolo-quinoline quinones (PQQ) or derivatives thereof.

13. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that the modified nucleic acid oligomer can sequence-specifically bind single-strand DNA, RNA, and/or PNA.

14. The modified nucleic acid oligomer according to claim 13, characterized in that the modified nucleic acid oligomer is a deoxyribonucleic acid oligomer, a ribonucleic acid oligomer, a peptide nucleic acid oligomer, or a nucleic acid oligomer having a structurally analogous backbone.

15. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that, alternatively, the catalytically redox-active moiety is covalently bound to one of the phosphoric-acid, carboxylic-acid, or amine groups, or to a sugar, especially to a sugar-hydroxyl group, of the nucleic acid oligomer backbone.

16. The modified nucleic acid oligomer according to one of claims 1 through 14, characterized in that, alternatively, the catalytically redox-active moiety is covalently attached to a thiol, hydroxyl, carboxylic-acid, or amine group of a modified base of the nucleic acid oligomer.

17. The modified nucleic acid oligomer according to claim 16, characterized in that the reactive thiol, hydroxyl, carboxylic-acid, or amine group of the base is covalently bound to the base via a branched or linear molecular moiety of any composition and chain length, the shortest continuous link between the thiol, hydroxyl, carboxylic-acid, or amine group and the base being a branched or linear molecular moiety having a chain length of 1 - 20 atoms, and especially of 1 - 14 atoms.

18. The modified nucleic acid oligomer according to one of claims 15 through 17, characterized in that the catalytically redox-active moiety is attached to an end of the nucleic acid oligomer backbone or to a terminal, modified base.

19. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that, following attachment to the nucleic acid oligomer, the catalytically redox-active moiety possesses catalytic activity.

20. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that, following attachment to the nucleic acid oligomer, the catalytically redox-active moiety possesses electrocatalytic activity.

21. The modified nucleic acid oligomer according to one of the preceding claims, characterized in that multiple catalytically redox-active moieties are attached to the nucleic acid oligomer.

22. A method of producing a modified nucleic acid oligomer as defined in one of the preceding claims, characterized in that a catalytically redox-active moiety is covalently attached to a nucleic acid oligomer.

23. The method of producing a modified nucleic acid oligomer according to claim 22, characterized in that the catalytically redox-active moiety is attached to a nucleic acid oligomer by covalently attaching one or more electron-donor molecule(s).

24. The method of producing a modified nucleic acid oligomer according to claim 23, characterized in that the catalytically redox-active moiety is completed by adding one or more electron-acceptor molecule(s) and/or one or more macromolecules and/or one or more proteins.

25. The method of producing a modified nucleic acid oligomer according to claim 22, characterized in that the catalytically redox-active moiety is attached to a nucleic acid oligomer by covalently attaching one or more electron-acceptor molecule(s).

26. The method of producing a modified nucleic acid oligomer according to claim 25, characterized in that the catalytically redox-active moiety is completed by adding one or more electron-donor molecule(s) and/or one or more macromolecules and/or one or more proteins.

27. The method of producing a modified nucleic acid oligomer according to claim 22, characterized in that the catalytically redox-active moiety is attached to a nucleic acid oligomer by covalently attaching one or more macromolecules.

28. The method of producing a modified nucleic acid oligomer according to claim 27, characterized in that the catalytically redox-active moiety is completed by adding one or more electron-acceptor molecule(s) and/or one or more electron-donor molecule(s) and/or one or more macromolecules.

29. The method of producing a modified nucleic acid oligomer according to claim 22, characterized in that the catalytically redox-active moiety is attached to a nucleic acid oligomer by covalently attaching one or more proteins.

30. The method of producing a modified nucleic acid oligomer according to claim 29, characterized in that the catalytically redox-active moiety is completed by adding one or more electron-acceptor molecule(s) and/or one or more electron-donor molecule(s) and/or one or more macromolecules.

31. The method of producing a modified nucleic acid oligomer according to one of claims 22 through 30, characterized in that, alternatively the nucleic acid oligomer is bound to the catalytically redox-active moiety by one or more amidations with amine or acid groups of the catalytically redox-active moiety, by one or more esterifications with alcohol or acid groups of the catalytically redox-active moiety, by thioester formation with thioalcohol or acid groups of the catalytically redox-active moiety, or by condensation of one or more amine groups of the nucleic acid oligomer with aldehyde groups of the catalytically redox-active moiety and subsequent reduction of the resultant carbon-nitrogen double bond.

32. The method of producing a modified nucleic acid oligomer according to one of claims 22 through 30, characterized in that one or more branched or linear molecular moieties of any composition and chain length are covalently attached to the catalytically redox-active moiety and the branched or linear molecular moieties possess, alternatively, a reactive amine, hydroxyl, thiol, acid, or aldehyde group for covalent attachment to a nucleic acid oligomer.

33. The method of producing a modified nucleic acid oligomer according to claim 32, characterized in that the shortest continuous link between the nucleic acid oligomer and the catalytically redox-active moiety is a branched or linear molecular moiety having a chain length of 1 - 20 atoms, and especially of 1 - 14 atoms.

34. A modified conductive surface, characterized in that one or more types of modified nucleic acid oligomers according to one of claims 1 through 21 are attached to a conductive surface.

35. The modified conductive surface according to claim 34, characterized in that the surface consists of a metal or a metal alloy, especially a metal selected from the group: platinum, palladium, gold, cadmium, mercury, nickel, zinc, carbon, silver, copper, iron, lead, aluminum, manganese, and their mixtures.

36. The modified conductive surface according to claim 34, characterized in that the surface consists of a semiconductor, especially a semiconductor selected from the group: carbon, silicon, germanium, and α-tin.

37. The modified conductive surface according to claim 34, characterized in that the surface consists of a binary compound of the elements of groups 14 and 16, a binary compound of the elements of groups 13 and 15, a binary compound of the elements of groups 15 and 16, or a binary compound of the elements of groups 11 and 17, especially a Cu(I) halide or an Ag(I) halide.

38. The modified conductive surface according to claim 34, characterized in that the surface consists of a ternary compound of the elements of groups 11, 13, and 16, or a ternary compound of the elements of groups 12, 13, and 16.

39. The modified conductive surface according to claims 34 through 38, characterized in that the attachment of the modified nucleic acid oligomers to the conductive surface occurs covalently or by chemisorption or physisorption.

40. The modified conductive surface according to one of claims 34 through 39, characterized in that, alternatively, one of the phosphoric-acid, carboxylic-acid, or amine groups, or a sugar group, especially a sugar-hydroxyl group of the nucleic acid oligomer backbone, is attached, covalently or by chemisorption or physisorption, to the conductive surface.

41. The modified conductive surface according to one of claims 34 through 39, characterized in that, alternatively, a thiol, hydroxyl, carboxylic-acid, or amine group of a modified base of the nucleic acid oligomer is attached, covalently or by chemisorption or physisorption, to the conductive surface.

42. The modified conductive surface according to claim 40 or 41, characterized in that the modified nucleic acid oligomer is bound to the conductive surface via a group at the end of the nucleic acid oligomer backbone or via a group of a terminal, modified base.

43. The modified conductive surface according to claims 34 through 42, characterized in that branched or linear molecular moieties of any composition and chain length are attached, covalently or by chemisorption or physisorption, to the conductive surface, and the modified nucleic acid oligomers are covalently attached to these molecular moieties.

44. The modified conductive surface according to claim 43, characterized in that the shortest continuous link between the conductive surface and the nucleic acid oligomer is a branched or linear molecular moiety having a chain length of 1 - 20 atoms, and especially of 1 - 12 atoms.

45. The modified conductive surface according to claim 43 or 44, characterized in that, alternatively, the branched or linear molecular moiety is attached to a phosphoric-acid, carboxylic-acid, or an amine group, or a sugar group, especially a sugar-hydroxyl group, of the nucleic acid oligomer backbone, or to a thiol, hydroxyl, carboxylic-acid, or amine group of a modified base of the nucleic acid oligomer.

46. The modified conductive surface according to claim 45, characterized in that the branched or linear molecular moiety is bound to a phosphoric-acid, sugar-hydroxyl, carboxylic-acid, or amine group at the end of the nucleic acid oligomer backbone or to a thiol, hydroxyl, carboxylic-acid, or amine group of a terminal, modified base.

47. The modified conductive surface according to one of claims 34 through 46, characterized in that predominantly one type of modified nucleic acid oligomer each is attached in a spatially delimited area of the conductive surface.

48. The modified conductive surface according to one of claims 34 through 46, characterized in that only one type of modified nucleic acid oligomer each is attached in a spatially delimited area of the conductive surface.

49. A method of producing a modified conductive surface as defined in claims 34 through 48, characterized in that one or more types of modified nucleic acid oligomers are applied to a conductive surface.

50. The method of producing a modified conductive surface as defined in claims 34 through 48, characterized in that one or more types of nucleic acid oligomers are applied to a conductive surface and, thereafter, a modification of the nucleic acid oligomers is carried out using a method according to claims 22 through 33.

51. The method of producing a modified conductive surface according to claim 49 or 50, characterized in that the nucleic acid oligomers or the modified nucleic acid oligomers are hybridized with the respective complementary nucleic acid oligomer strand and applied to the conductive surface in the form of the double-strand hybrid.

52. The method of producing a modified conductive surface according to claim 49 or 50, characterized in that the nucleic acid oligomer or the modified nucleic acid oligomer is applied to the conductive surface in the presence of further chemical compounds that are likewise attached to the conductive surface.

53. A method of electrochemically detecting oligomer hybridization events, characterized in that one or more modified conductive surfaces as defined in claims 34 through 48 are brought into contact with nucleic acid oligomers and, subsequently, detection of the electrical communication between the catalytically redox-active moiety and the respective conductive surface takes place.

54. The method according to claim 53, characterized in that detection takes place by cyclic voltammetry, amperometry, potentiometry, or conductivity measurement.

55. The method of electrochemical detection according to claim 53 or 54, characterized in that electrochemical detection is initiated by adding a substrate to the catalytically redox-active moiety attached to the conductive surface via a nucleic acid oligomer.

56. The method according to claim 55, characterized in that the addition of the substrate to the catalytically redox-active moiety attached to the conductive surface via a nucleic acid oligomer is limited to an area of the conductive surface having one or more modified nucleic acid oligomer types.

57. The method according to claim 55 or 56, characterized in that the substrate is a free redox-active substance not bound to but in contact with the nucleic acid oligomer and is selectively oxidizable and reducible at a potential φ, where the potential satisfies the condition $2.0\ V \geq \varphi \geq -2.0\ V$, measured against the normal hydrogen electrode.